4.14 ENERGY

This section includes discussions of impacts and mitigation measures related to transportation-related energy consumption in the study area. This section will focus primarily on the (Enhanced) Reduced Build Alternative. The (Enhanced) Reduced Build Alternative is the identified Preferred Alternative. The analysis estimates the total amount of energy expected to be consumed. Both direct (operational) energy and indirect (construction) energy impacts were assessed. (Note: Because the models used for calculating energy use are only in English units, such as British thermal units and miles, this discussion is only in English units. However, the results are converted into metric units.)

The additional analyses in this section were the result of refined engineering, responding to comments received during the public comment period of the August 2001 DEIR/EIS, and/or additional planning efforts. The added limits to the (Enhanced) Reduced Build Alternative would not contribute to any new environmental impacts. Potential environmental impacts from this added portion have been previously analyzed as part of the Full Build Alternative (SR-22/SR-55 HOV connector) and determined not to be substantial in regards to Energy. The comments and responses to comments are attached as Appendix A of this FEIS/EIR (Volumes II & III).

Direct energy consumption involves energy used by the operation of vehicles. In assessing the direct energy impact, consideration was given to the following factors:

- Vehicle mix, including light-duty vehicles (LDV), medium trucks (MT), and heavy trucks (HT)
- Annual Vehicle Miles Traveled (VMT)
- Variation of fuel consumption rates by vehicle type

The direct energy analysis for each alternative was based on projected year 2020 corridor traffic volumes and total VMT. The 2020 daily traffic volumes for the study corridor were obtained from the traffic analysis contained in Section 4.7 of this document, and Section 4.7 of the August 2001 DEIR/EIS for previously reviewed alternatives. The daily VMT was annualized using a factor of 335 days/year. The VMT Fuel Consumption Method utilized for this project is outlined in the *Energy and Transportation Systems* manual (California Department of Transportation, 1983)[1]. Energy consumption factors for the various modes identified in Table 4.14-1, were developed by Oak Ridge Laboratory and published in the 1996 *Transportation Energy Data Book: Edition 16*.

Table 4.14-1
ENERGY CONSUMPTION FACTORS

Mode	Factor
Passenger Vehicles (auto, van, light truck)	6,233 BTU[a]/Vehicle Mile
Heavy Truck	22,046 BTU/Vehicle Mile
Transit Bus (all vehicle types)	41,655 BTU/Vehicle Mile
Rail (light or heavy)	77,739 BTU/Vehicle Mile
Commuter Rail (Metrolink)	100,000 BTU/Vehicle Mile

Source: Oak Ridge Laboratory, 1996
Note:[a] BTU= British Thermal Unit, equal to the amount of heat required to raise one pound of water one degree Fahrenheit at one atmosphere of pressure

Indirect or construction energy effects involve the one-time, non-recoverable energy costs associated with construction of roadways, structures, and vehicles. The indirect energy analysis was conducted using the Input-Output Method. This method converts either VMT or 2000 construction dollars into energy consumption, based on existing data from other roadway improvement projects in the U.S., utilizing the conversions listed in Table 4.14-2, Construction Energy Consumption Factors.

Utilizing the annual direct energy savings and the energy consumed for construction, a payback period was calculated. The energy payback period is the amount of time it takes to recover the quantity of

[1] Both these publications are available at the California Department of Transportation, District 12.

energy expended for the construction of a project. The energy payback period is determined by dividing the construction energy by the annual operational energy savings due to the project (see example below).

Example Alternative
Construction Energy / Operational Energy Savings (Example Alternative - No Build) = Payback Period
240,000 barrels of oil /31,000 barrels of oil = 7.7 years

If the project would use more operational energy than the No Build Alternative, there is no annual energy savings compared to the No Build Alternative, and the payback period would never be met. A payback period of under five years is considered an excellent investment, while a payback period of greater than 20 years will generally be beyond the foreseeable future of the project (California Department of Transportation, 1983).

Table 4.14-2
CONSTRUCTION ENERGY CONSUMPTION FACTORS

Mode	Factor
Construction	
Automobiles and Trucks (manufacturing)	1,410 BTUs/Vehicle Mile[a]
Bus (manufacturing)	3,470 BTUs Vehicle Mile[a]
Roadway (construction)	27,500 BTUs/1977$[a,b]
Electrical (TSM Elements)	4,688 BTUs/1982$[a,b]
Maintenance	
Automobiles and Trucks	1,400 BTUs/Vehicle Mile[a]
Bus	13,142 BTUs/Vehicle Mile[a]

Source: [a] California Dept. of Transportation, 1983
Note: [b] 2001$ converted to 1977$ and 1982$

Both direct and indirect energy consumption are measured in British Thermal Units (BTUs). One BTU is the quantity of energy necessary to raise one pound of water one degree Fahrenheit at one atmosphere of pressure. BTUs have been converted to the equivalent barrels of crude oil for the comparison of alternatives.

4.14.1 DIRECT ENERGY (OPERATIONAL)

In the energy analysis, potential energy consumption of each alternative is compared to the No Build condition, rather than existing conditions. See discussion below and Table 4.14-3, Annual 2020 Direct Energy Consumption, which summarizes each alternative.

A. PREFERRED ALTERNATIVE/(ENHANCED) REDUCED BUILD ALTERNATIVE

Under the (Enhanced) Reduced Build Alternative, 2020 VMT for automobiles, trucks, and buses within the corridor, is forecast to be approximately 3.45 billion miles, the second highest of any of the alternatives. The increased VMT over the No Build and TSM/Expanded Bus Service Alternatives would result from an increase in the number of vehicles desiring to use SR-22 (added capacity would be an attraction to the facility) and additional buses operating within the corridor. Vehicles operating within the corridor are anticipated to expend approximately 25,500 billion BTUs or about 915 million liters (4.40 million barrels) of oil. Overall, the Full Build Alternative would result in the highest energy consumption for all alternatives. Annually, the Full Build Alternative would consume nearly 25 million more liters (118,903 more barrels) of oil than the No Build Alternative.

Table 4.14-3
ANNUAL 2020 DIRECT ENERGY CONSUMPTION

Description	No Build	TSM/Expanded Bus Service	Full Build	(Enhanced) Reduced Build
Vehicle Miles Traveled				
Light-duty Vehicles	3,202,164,098	3,225,591,961	3,387,137,475	3,288,482,985
Heavy Trucks	94,181,297	94,870,352	99,621,690	96,720,088
Buses	67,272,355	67,764,537	71,158,350	69,085,777
BTUs Consumed[a]				
Light-duty Vehicles (billions)	19,959	20,105	21,112	20,497
Heavy Trucks (billions)	2,076	2,092	2,196	2,132
Buses (billions)	2,802	2,823	2,964	2,878
Total BTUs Consumed (billions)	**24,838**	**25,019**	**26,272**	**25,507**
Total Barrels of Oil Consumed	**4,282,350**	**4,313,680**	**4,529,724**	**4,397,790**
Total Liters of Oil Consumed	**890,728,800**	**897,245,440**	**942,182,530**	**914,740,320**
Change in BTUs vs. No Build (billions)	---	**182**	**690**	**670**
Change in Barrels vs. No Build	---	**31,330**	**118,903**	**115,440**
Change in Liters vs. No Build	---	**6,516,640**	**24,731,865**	**24,011,520**

Source: [a] Oak Ridge National Laboratory, 1996

B. OTHER ALTERNATIVES

1. NO BUILD ALTERNATIVE

Under the No Build Alternative, the annual VMT for automobiles and trucks within the corridor is forecast to be 3.36 billion miles in 2020. Given the VMT and vehicle fuel consumption on an annual basis, vehicles operating within the corridor are anticipated to expend approximately 24,800 billion BTUs or about 891 million liters (4.28 million barrels) of crude oil. Overall, the No Build Alternative would result in moderate energy consumption. This is primarily due to the additional 20 million annual VMT this alternative has over the Build Alternative.

2. TSM/EXPANDED BUS SERVICE ALTERNATIVE

The TSM/Expanded Bus Service Alternative would have a higher VMT than the No Build or the Full Build Alternative, mostly as a result of the expanded bus service. The VMT for this alternative would be approximately 3.38 billion miles in 2020. With this VMT, the energy consumption would be approximately 25,020 billion BTUs or about 897 million liters (4.31 million barrels) of oil. This alternative would have the second highest energy consumption of any of the alternatives.

3. FULL BUILD ALTERNATIVE

Under the Full Build Alternative, 2020 VMT for automobiles, trucks, and buses within the corridor, is forecast to be nearly 3.55 billion miles in 2020. Vehicles operating within the corridor are anticipated to expend approximately 26,272 billion BTUs or about 950 million liters (4.59 million barrels) of oil. Overall, the Full Build Alternative consumes the most energy of all the alternatives. On an annual basis, this alternative would consume approximately 24.7 million liters more (nearly 119,000 more barrels) of oil than the No Build Alternative.

The California Energy Commission periodically forecasts the projected demand and supply of petroleum products, including gasoline and diesel. These products are market-driven commodities for which adequate supplies are anticipated through 2015. Because sufficient supplies of gasoline and diesel are expected to be available, the impact associated with an increase in energy, in regards to the Full Build Alternative, would be less than significant.

Thresholds of Significance for CEQA:

- Impacts to energy consumption

CEQA Findings:

A. PREFERRED ALTERNATIVE/(ENHANCED) REDUCED BUILD ALTERNATIVE

On an annual basis, the (Enhanced) Reduced Build Alternative would consume approximately 24 million more liters (115,440 more barrels) of oil than the No Build Alternative. Sufficient supplies of gasoline and diesel are expected to be available, therefore, this alternative is anticipated to have no significant impact on energy consumption.

B. OTHER ALTERNATIVES

1. NO BUILD ALTERNATIVE

This alternative is used as the baseline for comparison for all other alternatives. Predicted energy consumption in 2020 for the No Build Alternative would be about 891 million liters (4.28 million barrels) of crude oil. This alternative is anticipated to have no significant impact on energy consumption.

2. TSM/EXPANDED BUS SERVICE ALTERNATIVE

This alternative would have the second highest energy consumption among the alternatives under study, with a consumption of about 897 million liters (4.31 million barrels) of oil. However, this alternative is anticipated to have no significant impact on energy consumption because sufficient supplies of gasoline and diesel are projected.

3. FULL BUILD ALTERNATIVE

See the Full Build Alternative discussions above regarding energy consumption. This alternative is anticipated to have less than significant impact on energy consumption.

4.14.2 INDIRECT ENERGY (CONSTRUCTION)

The indirect energy consumption for each alternative is summarized in Table 4.14-4, Indirect Energy Consumption, and is discussed below.

A. PREFERRED ALTERNATIVE/(ENHANCED) REDUCED BUILD ALTERNATIVE

Structures and roadway construction costs of the (Enhanced) Reduced Build Alternative would consume nearly 1,512,000 barrels of oil, which is slightly less than the Full Build Alternative. Maintenance of vehicles within the study corridor would also be slightly less than the Full Build Alternative, and consume approximately 5,647 billion BTUs or about 973,660 barrels of crude oil. Overall energy consumption would be lower than the Full Build Alternative, consuming approximately 14,415 billion BTUs or about 517 million liters (2.49 million barrels) of oil. As shown in Table 4.14-4, Indirect Energy Consumption, there would be no direct energy savings associated with this alternative. As a result, there would be no energy savings to payback construction and maintenance costs.

Table 4.14-4
INDIRECT ENERGY CONSUMPTION

Description	No Build	TSM/ Expanded Bus Service	Full Build	(Enhanced) Reduced Build
Construction				
Corridor Annual VMT	*3,363,617,750.00*	*3,388,226,850.00*	*3,557,917,516*	*3,454,288,850.00*
Vehicles - Auto Mfg.[a] (BTUs)	4,647,847,006,950	4,681,851,861,330	4,913,330,442,918	4,773,136,332,930
Vehicles - Bus[a] (BTUs)	233,435,071,850	235,142,943,390	246,919,475,576	239,727,646,190
Roadway[a] (BTUs)			5,397,591,054,313	3,634,601,485,149
Electrical (TSM)[a] (BTUs)		120,719,744,409	120,719,744,409	120,719,744,409
Subtotal BTUs	*4,881,282,078,800*	*5,037,714,549,129*	*10,557,840,972,807*	*8,768,185,208,627*
Subtotal Barrels of Oil	*841,600*	*868,571*	*1,820,317*	*1,511,756*
Maintenance				
Auto Maintenance[a] (BTUs)	4,614,883,553,000	4,648,647,238,200	4,881,462,831,266	4,739,284,302,200
Bus Maintenance[a] (BTUs)	884,093,289,410	890,561,545,254	935,163,039,774	907,925,281,334
Subtotal BTUs	*5,498,976,842,410*	*5,539,208,783,454*	*5,816,625,871,040*	*5,647,209,583,534*
Subtotal Barrels of Oil	*948,099*	*955,036*	*1,002,866*	*973,657*
TOTAL BTUs	**10,380,258,921,210**	**10,576,923,332,583**	**16,374,466,843,847**	**14,415,394,792,212**
TOTAL BARRELS OF OIL	**1,789,700**	**1,823,607**	**2,823,183**	**2,485,413**
TOTAL LITERS	**372,257,600**	**379,310,256**	**587,222,064**	**516,965,904**
DIRECT ENERGY SAVINGS	**N/A**	**no savings**	**no savings**	**no savings**
PAYBACK PERIOD	**N/A**	**N/A**	**N/A**	**N/A**

Sources: [a] California Dept. of Transportation, 1983

B. OTHER ALTERNATIVES

1. NO BUILD ALTERNATIVE

There would be no construction costs beyond vehicle manufacturing associated with the No Build Alternative. The only indirect energy associated with the No Build Alternative would be the manufacturing and maintenance of vehicles within the study corridor. Automobile and bus manufacturing and maintenance would consume approximately 10,380 billion BTUs or about 372 million liters (1.79 million barrels) of crude oil. This alternative would consume the least amount of indirect energy.

2. TSM/EXPANDED BUS SERVICE ALTERNATIVE

Construction costs associated with this alternative would be primarily for signal synchronization/controller upgrades, automated response plan, highway advisory radio, changeable message signs, fleet management system, and transit intersection priority system. Indirect energy associated with these systems in addition to manufacturing and maintenance of vehicles would be approximately 10,577 billion BTUs or about 379 million liters (1.82 million barrels) of crude oil. Table 4.14-3, Annual 2020 Direct Energy Consumption, shows that there would be no direct energy savings associated with this alternative. As a result, there would be no energy savings to pay back construction and maintenance costs as shown in Table 4.14-4.

3. FULL BUILD ALTERNATIVE

Table 4.14-4, Indirect Energy Consumption, shows that structures and roadway construction costs would substantially add to the indirect energy consumed, while vehicle manufacturing

would be similar to other alternatives. The indirect energy associated with construction of the Full Build Alternative would be approximately 10,557 billion BTUs or about 1,820,317 barrels of oil. Maintenance of vehicles within the study corridor would be similar to the other alternatives, consuming approximately 5,816 billion BTUs or about 1,002,866 barrels of crude oil. Overall energy consumption would be the highest of all alternatives, consuming approximately 16,374 billion BTUs or approximately 587 million liters (2.82 million barrels) of oil. Therefore, there would be no annual energy savings.

4.14.3 MITIGATION

Due to the higher overall VMT associated with the TSM/Expanded Bus Service, (Enhanced) Reduced Build or the Full Build Alternatives, measures would have to be implemented to reduce the VMT to below the No Build Alternative, and to provide savings in direct energy. However, the impacts on energy usage would be small, so mitigation is not required.

Further improvements in the energy efficiency would require an increase in HOV lane usage (if available) and transit ridership through measures such as:

- Expanded marketing programs
- Increased connectivity of the transit system serving the area
- Improved patron access to station areas via expanded feeder service, pedestrian amenities, convenient parking and facilities supporting other non-motorized modes of station access

4.14.4 RESIDUAL IMPACTS AFTER MITIGATION

A. PREFERRED ALTERNATIVE/(ENHANCED) REDUCED BUILD ALTERNATIVE

Less than substantial.

B. OTHER ALTERNATIVES

1. NO BUILD ALTERNATIVE

None.

2. TSM/EXPANDED BUS SERVICE ALTERNATIVE

Less than substantial.

3. FULL BUILD ALTERNATIVE

Less than substantial.